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Michalski, Grzegorz

Wroclaw University of Economics, Poland

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# **RISK-BASED CASH DEMAND IN A FIRM**

Grzegorz Michalski<sup>1</sup>

## **Abstract**

Maximization of enterprise owner's wealth is the basic financial aim in management. Cash management must contribute to the realization of this aim. This article presents a determination method for precautionary and speculative levels of cash in a firm. High levels of cash in a firm increase net working capital and costs of holding cash: both of which decrease the value of a firm.

## **Keywords:**

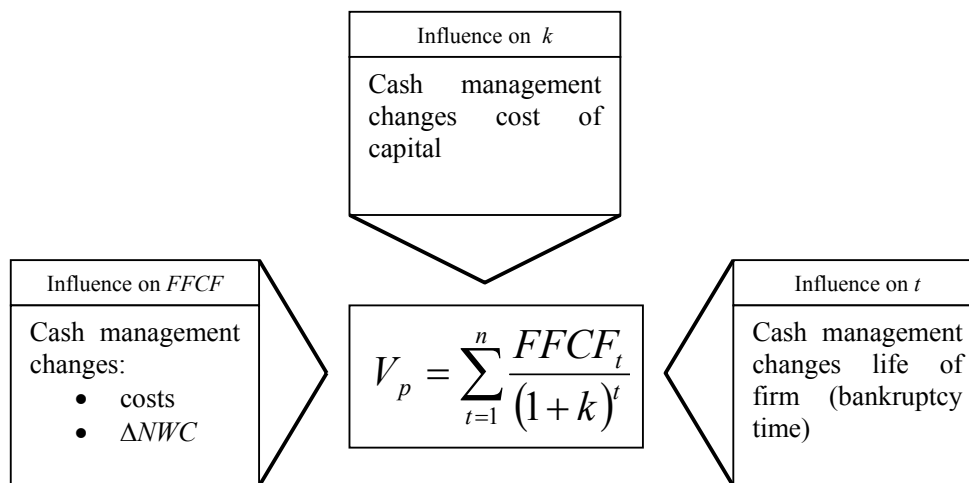
Demand for Cash, Cash balances, Risk, Uncertainty, Real Options, Option Value of Money, Short-Term Financial Management, Working Capital Management

## **1. Introduction**

Corporate cash management depends on demands for cash in a firm. The aim of cash management is such that limiting cash levels in the firm maximizes owner wealth. Cash levels must be maintained so as to optimize the balance between costs of holding cash and the costs of insufficient cash. The type and the size of these costs are partly specific to the financial strategy of the firm.

In addition, cash management influences firm value, because its cash investment levels entail the rise of alternative costs, which are affected by net working capital levels. Both the rise and fall of net working capital levels require the balancing of future free cash flows, and in turn, result in firm valuation changes.

Figure 1: The Cash Level Influence on Firm Value.



Where:  $FFCF$  = Future Free Cash Flows;  $\Delta NWC$  = Net Working Capital Growth;  $k$  = cost of the capital financing the firm;  $t$  - the lifetime of the firm and time to generate single  $FFCF$ .

If the advantages of holding cash at a chosen level are greater than the influence of the alternative costs of holding cash, thereby increasing net working capital, then firm's value will also increase. The net working capital (current assets less current liabilities) results from lack of synchronization of the formal rising receipts and the real cash receipts from each sale. Net working capital also results from divergence during time of rising costs and time, from the real outflow of cash when a firm pays its accounts payable.

<sup>1</sup> Dr Grzegorz Michalski, University of Economics in Wrocław, Department of Corporate Finance and Value Management, ul. Komandorska 118/120, pok. 704-Z, PL53-345 Wrocław, Grzegorz.Michalski@ae.wroc.pl ; <http://michalskig.com/>

$$NWC = CA - CL = AAR + ZAP + G - AAP \quad (1)$$

Where:  $NWC$  = Net Working Capital,  $CA$  = Current Assets,  $CL$  = Current Liabilities,  $AAR$  = Accounts Receivables,  $ZAP$  = Inventory,  $G$  = Cash and Cash Equivalents,  $AAP$  = Accounts Payables.

When marking free cash flows, cash possession and increased net working capital is the direct result of amounts of cash allocated for investment in net working capital allocation. If an increase of net working capital is positive, then we allocate more money for net working capital purposes and thereby decrease future free cash flow. It is important to determine how changes in cash levels change a firm's value. Accordingly, we use equation, based on the premise that a firm's value is the sum of its discounted future free cash flows to the firm.

$$\Delta V_p = \sum_{t=1}^n \frac{\Delta FFCF_t}{(1+k)^t}, \quad (2)$$

Where:  $\Delta V_p$  = Firm Value Growth,  $\Delta FFCF_t$  = Future Free Cash Flow Growth in Period  $t$ ,  $k$  = Discount Rate<sup>2</sup>.

Future free cash flow we have as:

$$CF_t = (CR_t - FC_{WD} - VC_t - D) \times (1 - T) + D - \Delta NWC_t \quad (3)$$

Where:  $CR_t$  = Cash Revenues on Sales,  $FC_{WD}$  = Fixed Costs,  $VC_t$  = Variable Costs in Time  $t$ ,  $D$  = Depreciation,  $T$  = Effective Tax Rate,  $\Delta NWC$  = Net Working Capital Growth.

Changes in precautionary cash levels affect the net working capital levels and as well the level of operating costs of cash management in a firm. Companies invest in cash reserves for three basic reasons:

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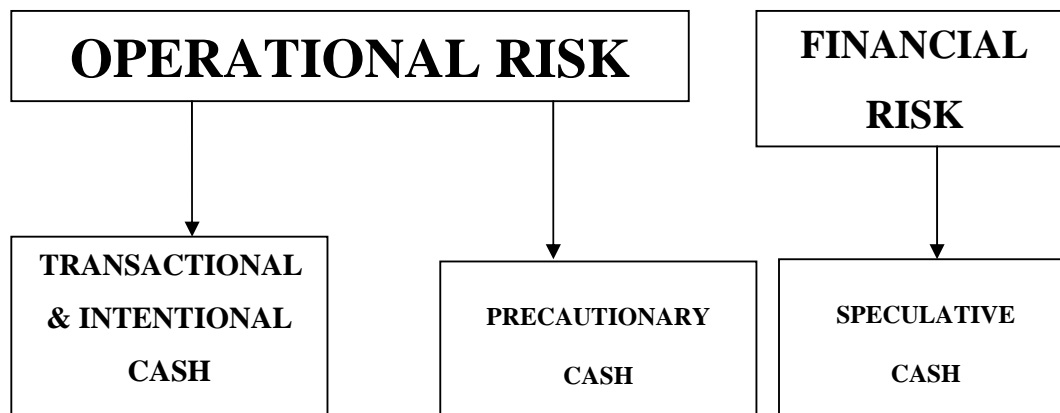
<sup>2</sup> To estimate changes in cash management, we accept discount rate equal to the average weighed cost of capital (WACC). Such changes and their results are strategic and long term, although they refer to cash and short term area decisions [T.S. Maness 1998, s. 62-63].

First, firms are guided by transactional and intentional motives resulting from the need to ensure sufficient capital to cover payments customarily made by the company. A firm retains transactional cash to ensure regular payments to vendors for its costs of materials and raw materials for production. As well, a firm retains intentional cash for tax, social insurance and other known non-transactional payment purposes.

Second, firms have precautionary motives to invest in cash reserves in order to protect the company from the potential negative consequences of risk, which are unexpected, negative cash balances that can occur as a result of delays in accounts receivable collection or delays in receiving other expected monies.

Third, companies have speculative motives<sup>3</sup> to retain cash reserves. Speculative cash makes it possible for the firm to use the positive part of the risk<sup>4</sup> equation to its benefit. Companies hold speculative cash to retain the possibility of purchasing assets at exceptionally attractive prices.

*Figure 2: Reasons for Holding Cash by Companies and Their Relation to the Risk.*



## 2. Transactional and Intentional Cash Management

<sup>3</sup> [M.H. Miller 1966, s. 417-418].

<sup>4</sup> We define risk as the probability of obtaining a different effect than anticipated. Companies hold speculative cash to benefit from chance. Chance is the positive part of the risk equation, or the probability of obtaining an effect that is better than anticipated.

For the purposes of this study, there are two approaches to determining intentional and transaction cash levels in a firm. First, to foresee intentional cash needs, we use ordinary predictors of such events, including the necessity of tax payments, social insurance etc. We also predict the need to perform obligations that result from investment purchases, or other intentional, earlier-known expenses. Second, transaction cash levels are determined by experience and expectations about transaction cash inflows and outflows. Cash outflows are often under a firm's control, but can also be hard to anticipate. With knowledge of present and historical cash inflows and outflows, it is possible to notice, that there are four basic situations referring to transactional operating cash flows in a company:

- (1) when future cash inflows and outflows are possible to anticipate, and inflows are expected to be greater than outflows,
- (2) when future cash inflows and outflows are possible to anticipate, and outflows are expected to be greater than inflows,
- (3) when future cash inflows and outflows are possible to anticipate, but neither is expected to be greater,
- (4) when future cash inflows and outflows are impossible to anticipate.

Knowing the character and the size of cash inflows and outflows, we can use one of the four models to determine management of cash levels. Of course, it is not necessary that only one situation occur at all times within the firm; the same company can experience both time when expected cash inflows are greater than outflows and at others times it can experience times when expected cash outflows are greater than inflows. This is similar to the predictability of future cash inflows and outflows. In the firm, there are periods when it is possible to foresee cash inflows and outflows, yet there are other periods which predicting cash inflows and outflows can be very difficult or entirely impossible.

Using information about future cash inflows and outflows, we are able to apply, for example, the Baumol model or the Beranek model. If we anticipate that cash inflows are greater than outflows, we are able to use the Beranek model [W. Beranek 1963 also: F. C. Scherr 1989, pp. 131-132] to determine cash flow management within a firm. On the other hand, if we predict that cash outflows are greater than inflows we use Baumol model [W. Baumol 1952]. When we cannot forecast long-term cash flows, for a period longer than approximately 14 days, we are able to use the Stone model [B. Stone 1972; T. W. Miller 1996] to determine cash flow management. However, when we cannot predict future cash inflows and outflows at all, the Miller-Orr model<sup>5</sup> can be used to determine cash flow management.

### **3. Precautionary Cash Management - Safety Stock Approach**

Current models for determining cash management, for example Baumol, Beranek, Miller-Orr or Stone models, assign no minimal cash level, and are based on the manager's intuition. In addition, these models are based inventory managements models. In this study, we address the potential for adaptation of these methods of determining safety stock to determine minimal cash levels in the firm. Safety stock is a result of information about the risk of inventories. To calculate safety stock we use Equation 4 [M. Piotrowska 1997, p. 57]:

$$Z_b = \sqrt{-2 \times s^2 \times \ln \frac{C \times Q \times s \times v \times \sqrt{2\Pi}}{P \times K_{bz}}} \quad (4)$$

Where:  $z_b$  = Safety Stock,  $C$  = Cost of Inventories (in percentage),  $Q$  = One Order Quantity,  $v$  = Cost of Inventories (Price),  $P$  = Yearly Demand for Inventories,  $s$  = Standard Deviation of Inventory Spending,  $K_{bz}$  = Cost of Inventories Lack.

It is also possible to apply the following equation to determine minimal cash level [G.

Michalski 2006]:

$$LCL = \sqrt{-2 \times s^2 \times \ln \frac{k \times G^* \times s \times \sqrt{2\Pi}}{P \times K_{bsp}}} \quad (5)$$

Where:  $LCL$  = Low Cash Level (Precautionary Cash Level),  $k$  = Cost of Capital,  $G^*$  = Average Size of One Cash Transfer<sup>6</sup> which are the basis of standard deviation calculation,  $P$  = the Sum of all Cash Inflows and Outflows in the Period,  $s$  = Standard Deviation of Daily Net Cash Inflows/Outflows,  $K_{bsp}$  = Cost of Cash Lack.

Part of the information necessary to determine  $LCL$ , still requires the manager's intuition. For example, costs of lack of cash, contains not only costs known from accountant records, but also other costs, such as opportunity costs. Precautionary cash reserves are, first of all the result of anxieties before negative results of risk. Its measure is the standard deviation.

**Example 1.** Managers of the firm X, value the cost of the lack of cash as 5000. The day's standard deviation of cash inflows/outflows is 35,466 monthly. Average single cash inflow/outflow is 27,250. The monthly sum all cash inflow/outflow is: 817,477. The alternative cost of capital is 18%.

For the firm X, precautionary cash level is:

$$LCL_1 = \sqrt{-2 \times 35\,466^2 \times \ln \frac{0,18}{360} \times 27\,250 \times 35\,466 \times \sqrt{2\Pi}} = 142\,961.42$$

When cash outflows and inflows volatility is 0, precautionary cash balance is also 0:

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<sup>5</sup> [M. H. Miller 1984] also: [G. Michalski 2005].

<sup>6</sup> In Beranek model and Baumol models,  $G^*$  is twice optimal cash level. In Stone and Miller-Orr models, the average transfer  $G^*$  is assigned from real historic data or from its anticipation.



$$LCL_0 = 0$$

Then we can estimate net working capital growth:

$$\Delta NWC = LCL_1 - LCL_0 = 142\,961,42 = -\Delta CF_{t=0}$$

The standard deviation is 35,466 and tax rate is 20%. So, we can estimate yearly alternative cost precautionary cash reserves and the influence on the value of the firm:

$$\Delta TCC = \Delta NWC \times k = 142\,961,42 \times 0.18 = 25,733 = \frac{-\Delta CF_{t=1 \dots \infty}}{(1-T)} ;$$

$$\Delta V = \Delta CF_{t=0} + \frac{(\Delta CF_{t=1 \dots \infty}) \times (1-T)}{k} = -142,961,42 + \frac{-25,733 \times 0.8}{0.18} = -257,330$$

As demonstrated in order for the precautionary cash balance to remain level, with the standard deviation equal to 35,466; a decrease in the firm's value of 257,330 results.

#### 4. Speculative Cash Balance Management - Option Approach

All firms do not necessarily hold speculative cash balances. Speculative cash is held in order to utilize the positive part of the risk equation. Firms want to retain opportunities that result from price volatility. For example, in the ordinary practice of Polish firms, we see that speculative cash balances can be useful to benefit from transactions in foreign exchanges. It can be profitable for firms to purchase necessary products or services in foreign exchange at prices cheaper than its average purchase price. Such purchase is possible if the firm maintains speculative cash balances. Speculative cash balances give the firm the ability to use of their purchasing power any time. Such cash superiority over other assets shows option value of speculative cash balances<sup>7</sup>.

**Example 2.** The entrepreneur can choose from one of two possibilities:

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<sup>7</sup> [S. E. Beck 1993]. Cash we can compare to American option without *expiration date*. Other near to cash assets can be compared to European option, see: [J. Ingersoll 1992, pp. 5-6, and S. E. Beck 1993]. The right to faster acquisition has a value, and such value gives base to have speculative cash balances. Costs of expectation on

- He can to invest in the firm activity, for example, he can purchase in foreign exchange,  
or
- He can decide to hold cash (national currency).

Entrepreneur make the decision between these two possibilities at least once every day. The purchase of foreign exchange and its use in the operating activity of a firm makes other cash resources inaccessible for continued speculation. If the entrepreneur chooses to hold cash, he still has the possibility to purchase foreign exchange. Yet, foreign exchange price changes from day to day. The daily standard deviation of the foreign exchange price is 4%. This means that the foreign exchange price today is 1.00 PLN. The next day the foreign exchange price can be 1.04 PLN with the probability 0.5; or 0.96 PLN with the probability 0.5.

Suppose that next, the foreign exchange price meets its long-term value of 1.00 PLN. If on the first day, an entrepreneur decides to hold cash, and the next day's foreign exchange price falls to the level of 0.96 PLN (lower than its expected value), the entrepreneurs expected income will be 0.04 PLN. On the other hand, if the foreign exchange price reaches the level of 1.04 PLN (above its expected value), then the entrepreneur won't purchase foreign exchange, and his expected income will be 0 PLN. So, if an entrepreneur has cash for 10,000 foreign exchange units, his expected value of the benefit of holding in national currency (in cash) by one day, will be:

$$E(\text{benefit}) = \sum_{i=1}^n \text{benefit} \times p_i = \frac{0.04\text{PLN} \times 10,000}{1.0005} \times 0.5 + 0\text{PLN} \times 0.5 \approx 199.90 \text{ PLN}$$

The daily alternative cost of capital financing for the firm is:

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realization of other options can cause loss that is not recovered by future earnings from these (less liquid than cash) assets, see: [S. E. Beck 2005].

$$\frac{18\%}{360} = 0.05\%$$

Therefore, we can also express it for 10,000 foreign exchange units:

$$0.05\% \times 10,000 = 5 \text{ PLN}.$$

This means that the expected benefit is 199.9 PLN. This demonstrates the basis for holding speculative cash balances in a firm. Of course, the size of speculative cash balances should be an effect of the firm's customary activities and its real operational needs. The legitimacy of holding speculative cash balances increases here together with the increase of volatility of foreign exchange pricing (or volatility of the price of any other assets necessary to the firm) and grows smaller together with the height of the alternative costs of capital financing for the firm.

## Summary

Firms hold cash for a variety of different reasons. Generally, cash balances held in a firm can be called considered, precautionary, speculative, transactional and intentional. The first are the result of management anxieties. Managers fear the negative part of the risk and hold cash to hedge against it. Second, cash balances are held to use chances that are created by the positive part of the risk equation. Next, cash balances are the result of the operating needs of the firm. In this article, we analyse the relation between these types of cash balances and risk. This article also contains propositions for marking levels of precautionary cash balances and speculative cash balances. Application of these propositions should help managers to make better decisions to maximize the value of a firm.

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